Assignment-04

We have created a Dumbbell topology with two routers R1 (Node 0) and R2 (Node 1) connected by a (10 Mbps, 50 ms) wired link. Each of the routers is connected to 3 hosts i.e., H1 to H3 (i.e. senders) are connected to R1 and H4 to H6 (i.e. receivers) are connected to R2. The hosts are attached with (100 Mbps, 20ms) links. Both the routers use drop-tail queues with queue size set according to bandwidth-delay product. Senders (i.e. H1 (Node 2), H2 (Node 3) and H3 (Node 4)) are attached with TCP Hybla, TCP Westwood+, and TCP YeAH-TCP agents to Receivers (i.e. H4 (Node 5), H5 (Node 6), H6 (Node 7)) respectively.

We used NS3 3.30 flow monitor module to collect and store performance data from the simulation.

1)

How we have selected the duration?

We were asked to monitor each flow individually over a sufficiently long duration. Since here we have setup the application socket with a data transfer rate of 50Mbps and since we are transmitting 1000000 packets of 1.5KB each, the minimum time required to transmit all packets = (1000000*1.5*1024*8)/(50000000) i.e. approximately 250 seconds. However, this duration is for the ideal situation when there is no buffering and delay at the routers. Therefore, judging the situation we observed each flow for 500 seconds during which the outputs monotonised and fell into a repetitive pattern and there was no appreciable difference noted in the pattern of the output.

Attached below are the output graphs for the three congestion protocols that we have used, namely, TCP Hybla, TCP Westwood+ and TCP Yeah.

- **TCP Hybla Flow**:

Total Packets transmitted: 1000000

Total Packets Lost: 29

Packets Lost due to buffer overflow: 0

Packets Lost due to Congestion: 29

Maximum throughput (in kbps): 3714.58

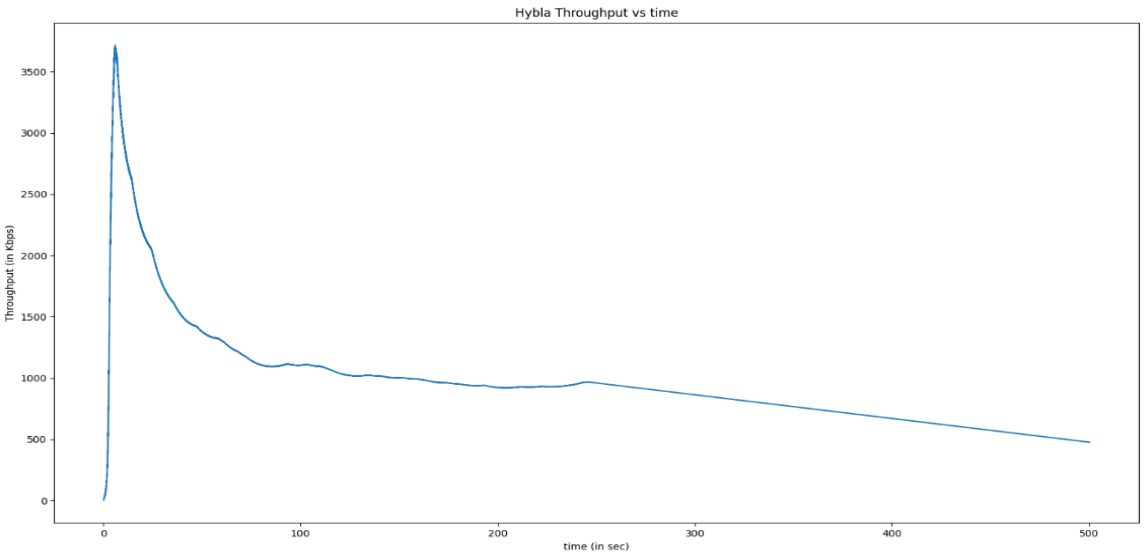
Packets Successfully Transferred: 999971

Percentage of packet loss (total): 0.0029

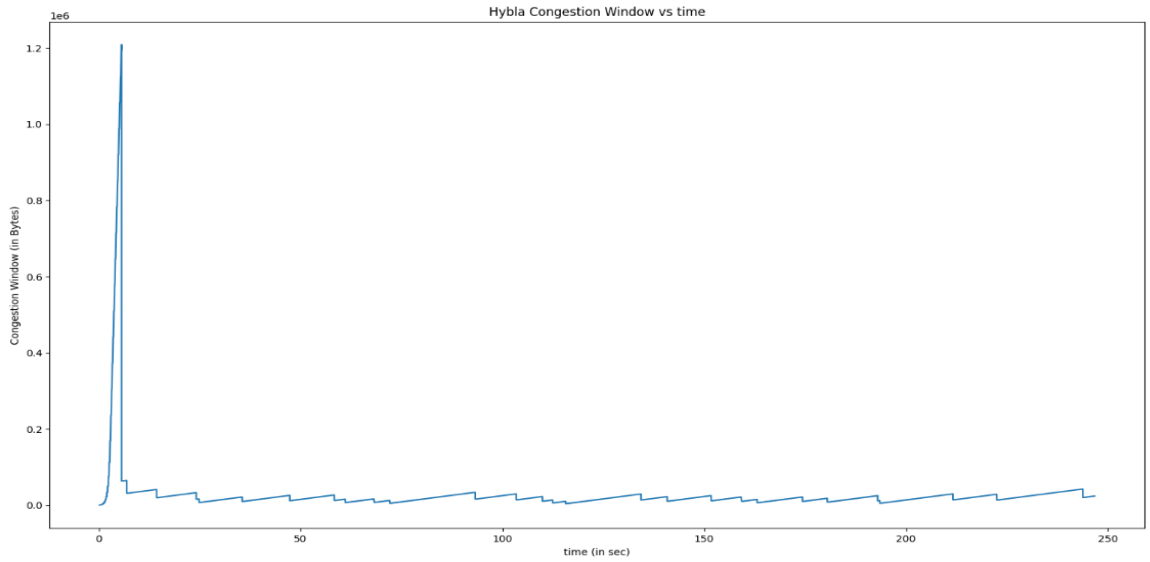
Percentage of packet loss (due to buffer overflow): 0.0

Percentage of packet loss (due to congestion) or Congestion Loss: 0.0029

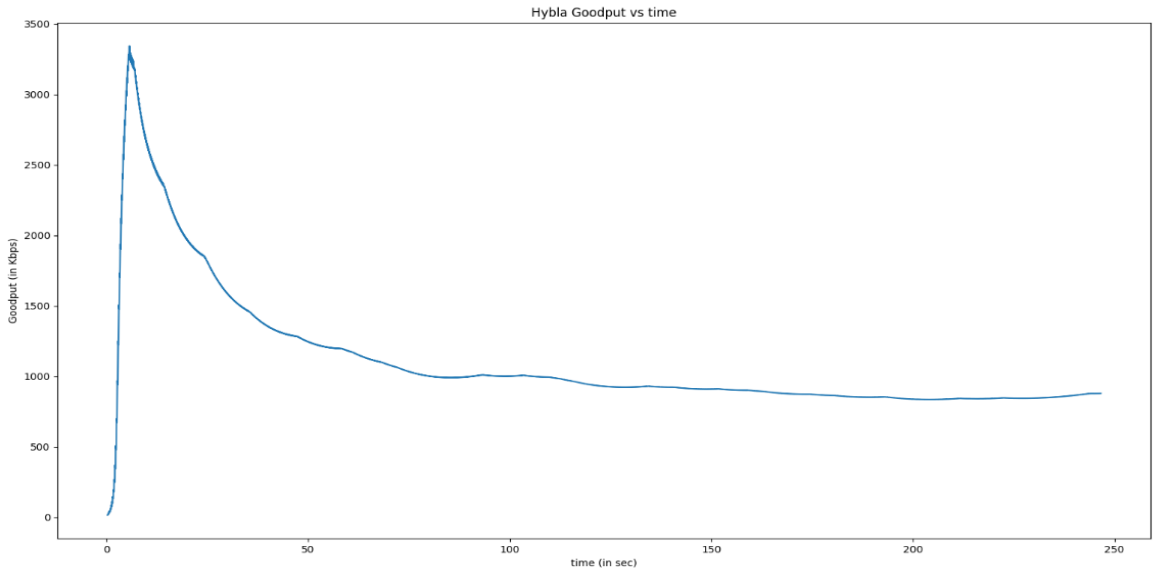
Hybla Throughput vs time:



Evolution of congestion window w.r.t time:



Hybla Goodput w.r.t time:



- **<u>TCP Westwood+ Flow</u>**:

Total Packets transmitted: 1000000

Total Packets Lost: 35

Packets Lost due to buffer overflow: 0

Packets Lost due to Congestion: 35

Maximum throughput (in kbps): 2658.21

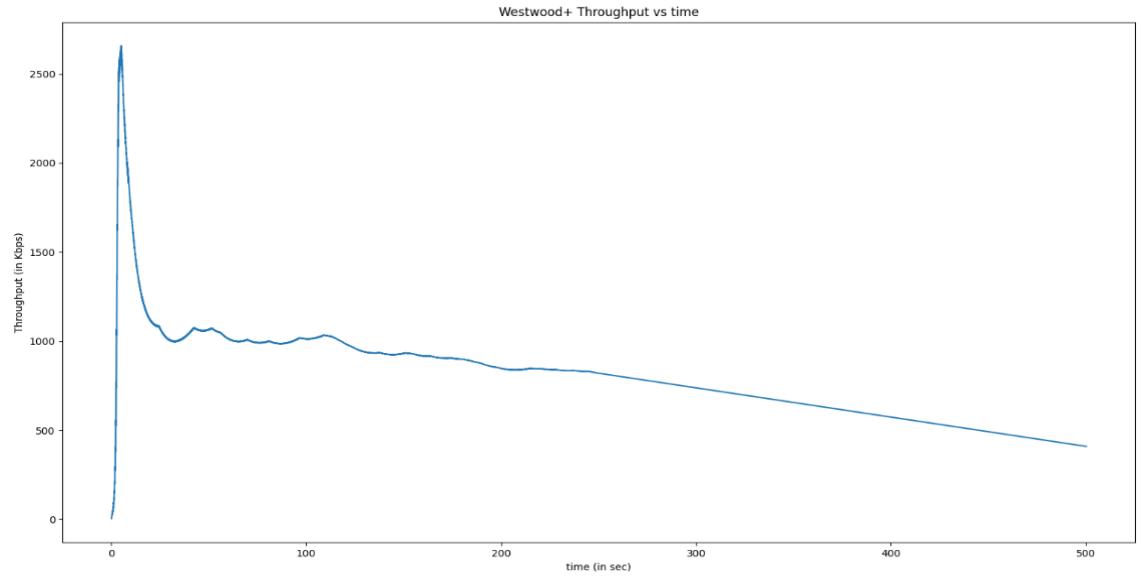
Packets Successfully Transferred: 999965

Percentage of packet loss (total): 0.0035

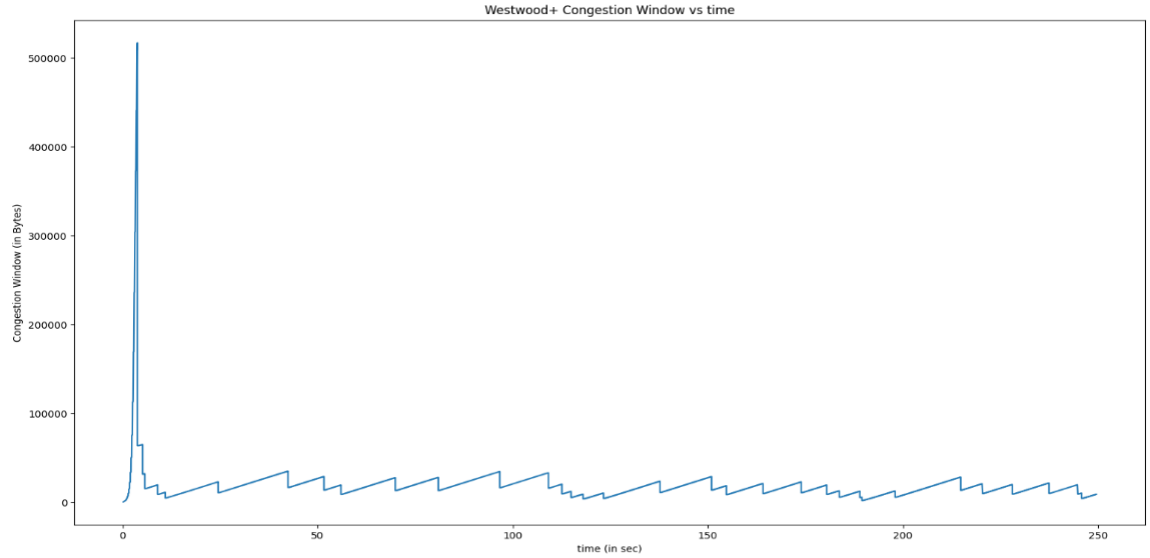
Percentage of packet loss (due to buffer overflow): 0.0

Percentage of packet loss (due to congestion) or Congestion Loss: 0.0035

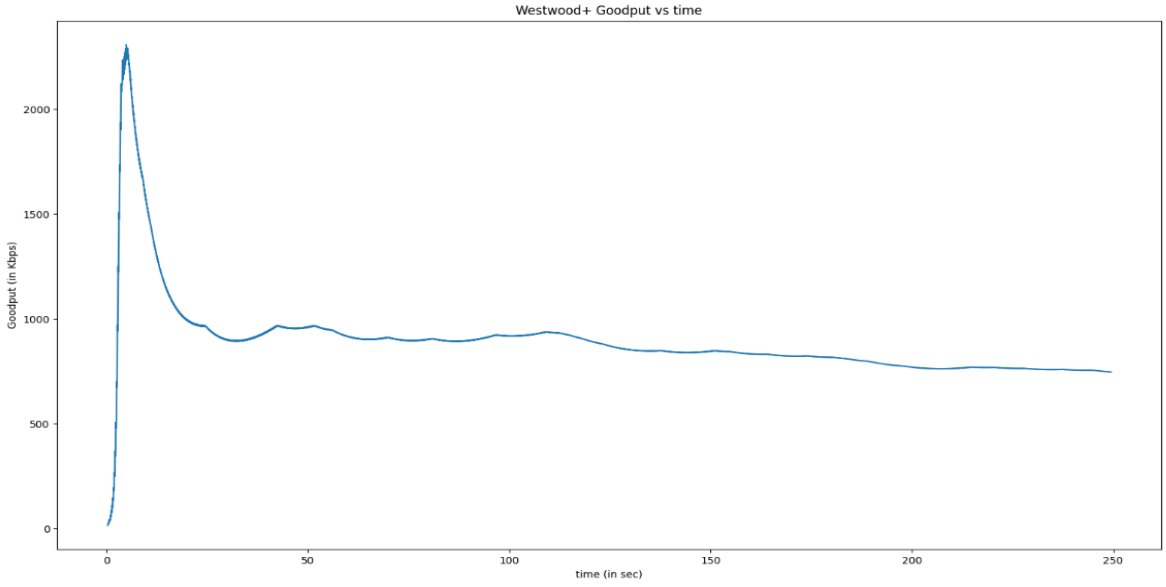
Westwood+ Throughput vs time:



Evolution of congestion window w.r.t time:



Westwood+ Goodput w.r.t time:



- **<u>YeAH-TCP Flow</u>:**

Total Packets transmitted: 1000000

Total Packets Lost: 31

Packets Lost due to buffer overflow: 0

Packets Lost due to Congestion: 31

Maximum throughput (in kbps): 1006.31

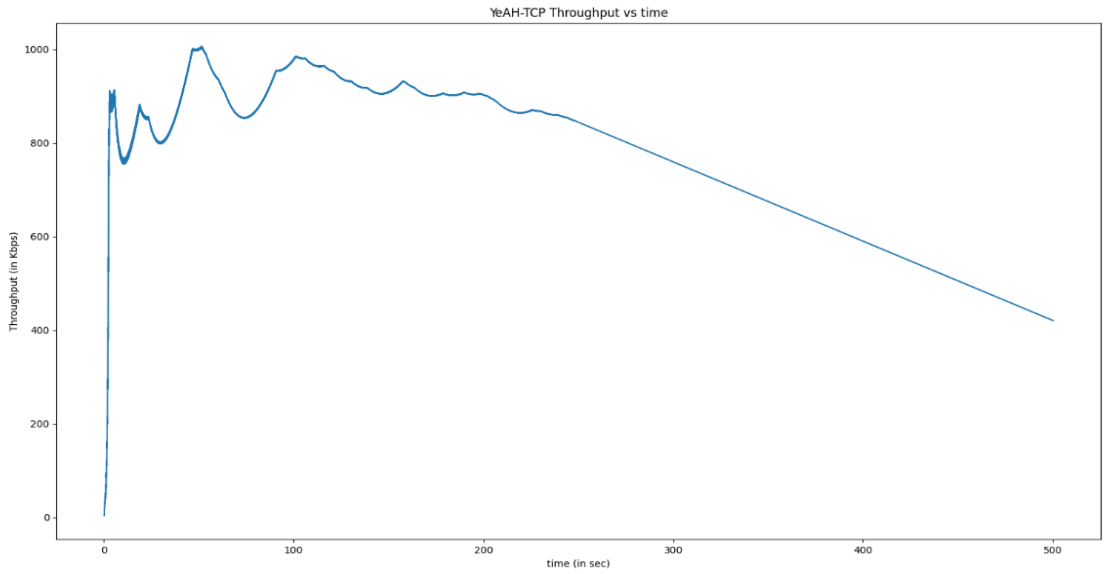
Packets Successfully Transferred: 999969

Percentage of packet loss (total): 0.0031

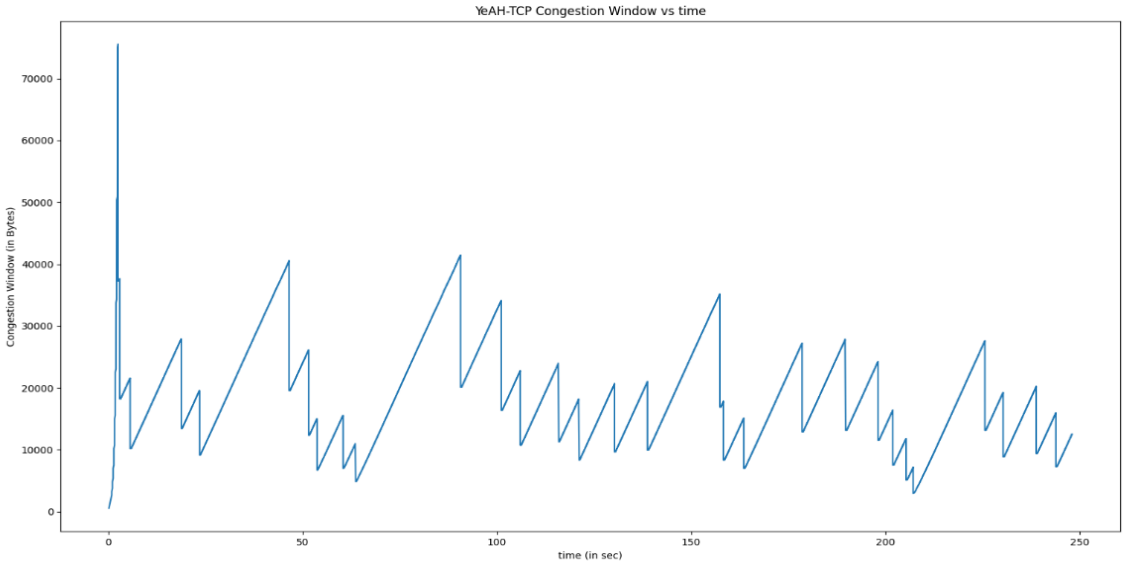
Percentage of packet loss (due to buffer overflow): 0.0

Percentage of packet loss (due to congestion) or Congestion Loss: 0.0031

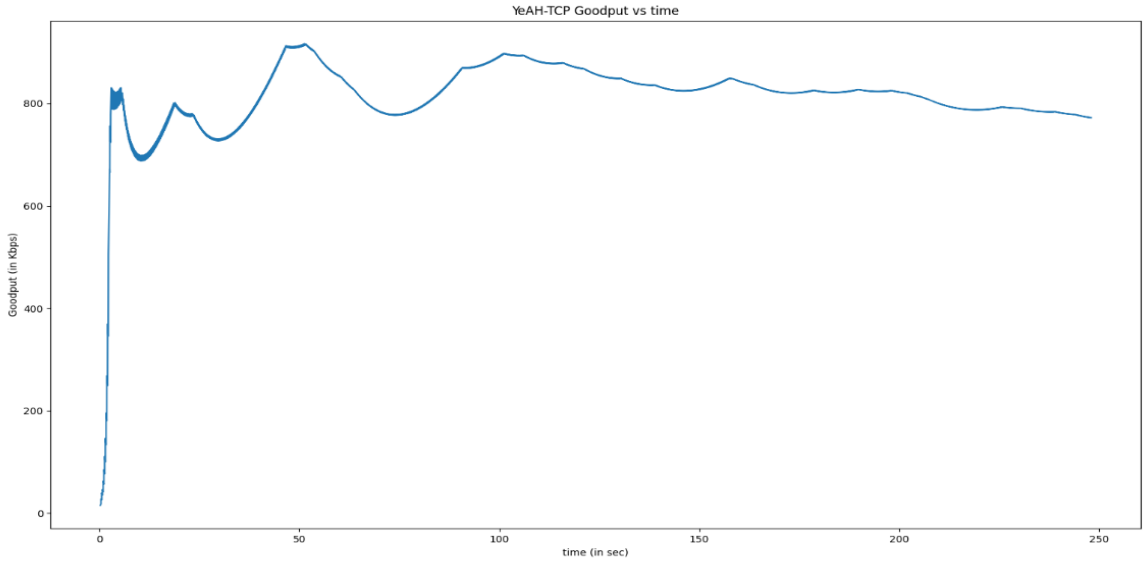
YeAH-TCP Throughput w.r.t time:



Evolution of congestion window w.r.t time:



YeAH -TCP Goodput w.r.t time:



2)

How we have selected the duration here?

(Same as part(1))

Since here we have setup the application socket with a data transfer rate of 50Mbps and since we are transmitting 1000000 packets of 1.5KB each, the minimum time required to transmit all packets = (1000000*1.5*1024*8)/(50000000) i.e. approximately 250 seconds. However, this duration is for the ideal situation when there is no buffering and delay at the routers. Therefore, judging the situation we observed each flow for 500 seconds during which the outputs monotonised and fell into a repetitive pattern and there was no appreciable difference noted in the pattern of the output.

Also, we were asked to start two other TCP flows simultaneously while the first one was in progress. Hence, we started the TCP Hybla flow initially and after a duration of 20 seconds the other two were started.

- **TCP Hybla Flow**:

Total Packets transmitted: 1000000

Total Packets Lost: 30

Packets Lost due to buffer overflow: 0

Packets Lost due to Congestion: 30

Maximum throughput (in kbps): 3714.58

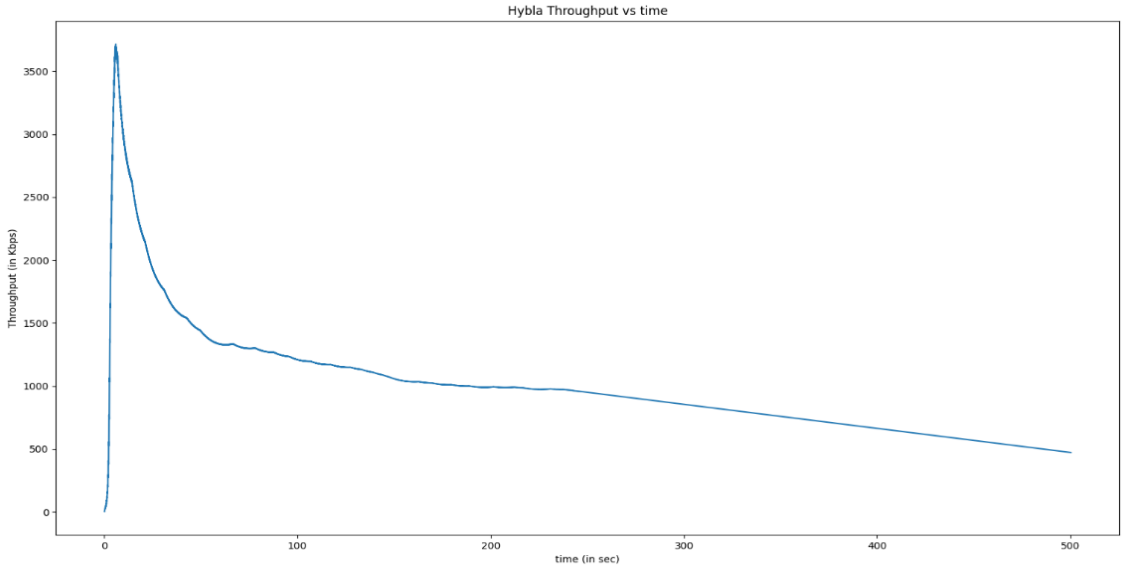
Packets Successfully Transferred: 999970

Percentage of packet loss (total): 0.003

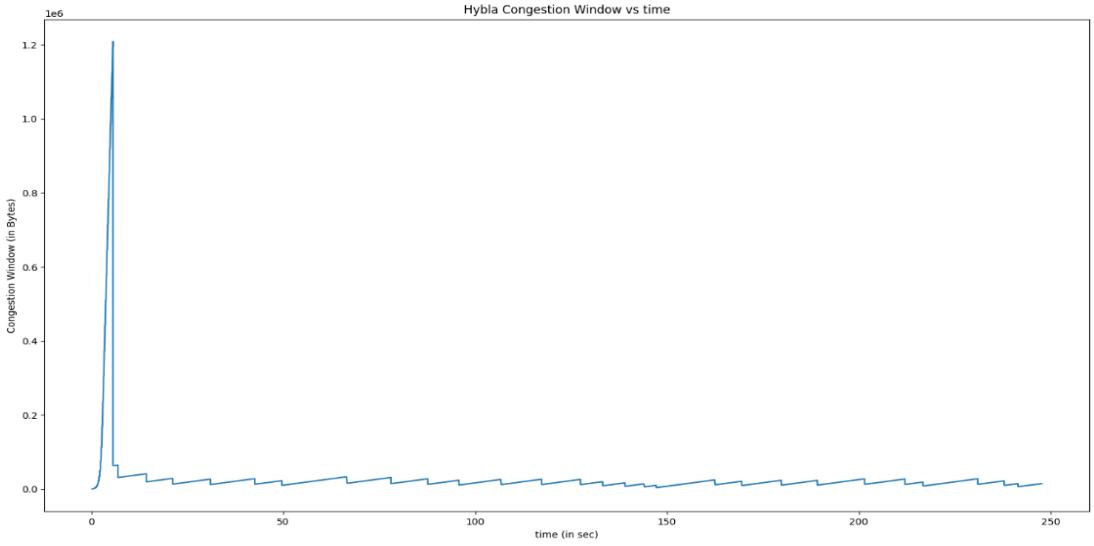
Percentage of packet loss (due to buffer overflow): 0.0

Percentage of packet loss (due to congestion) or Congestion Loss: 0.003

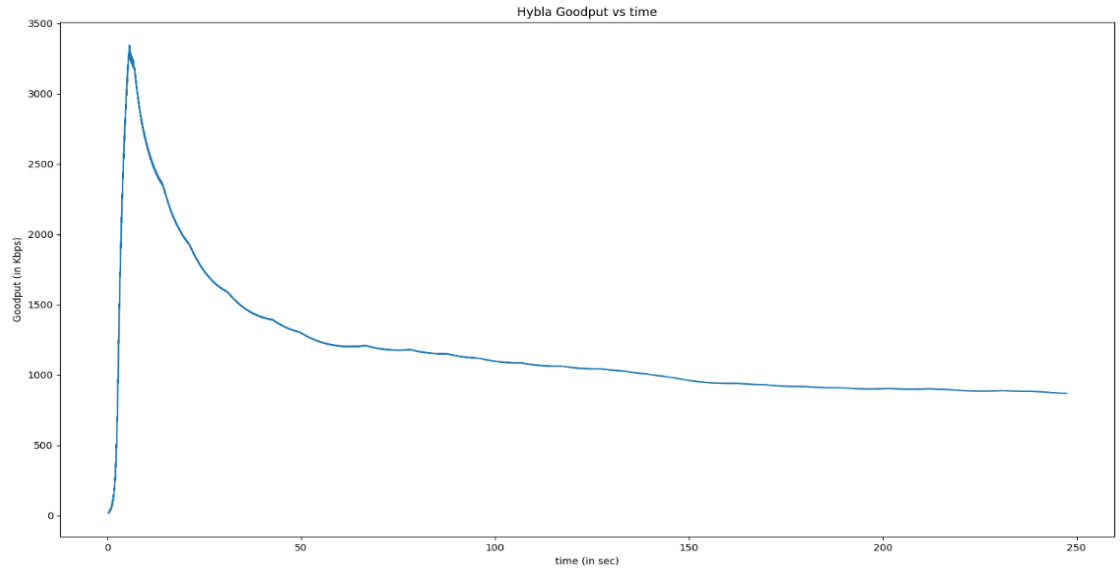
Hybla Throughput vs time:



Evolution of congestion window w.r.t time:



Hybla Goodput w.r.t time:



- **<u>TCP Westwood+ Flow</u>:**

Total Packets transmitted: 1000000

Total Packets Lost: 39

Packets Lost due to buffer overflow: 0

Packets Lost due to Congestion: 39

Maximum throughput (in kbps): 790.654

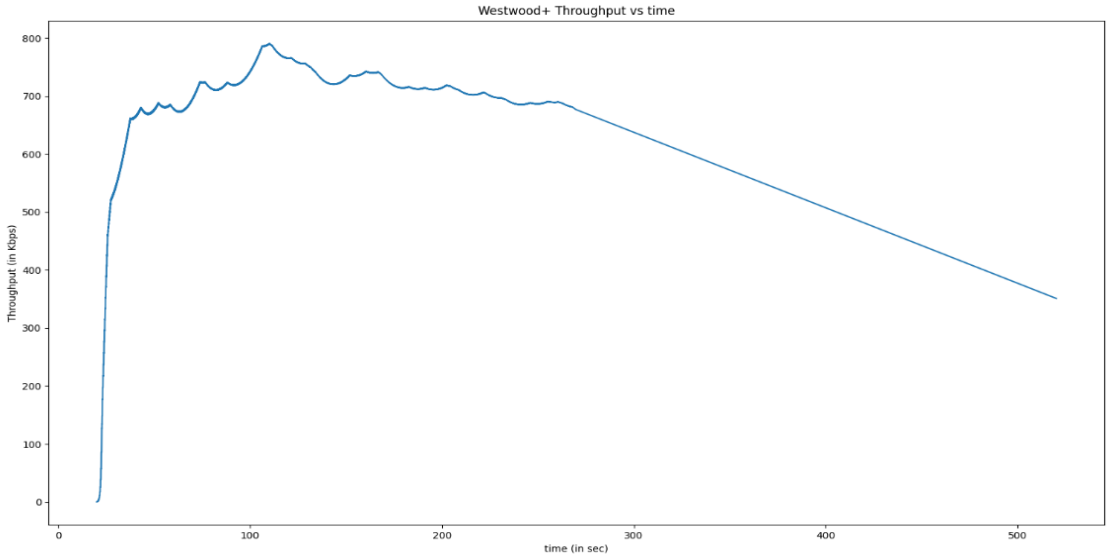
Packets Successfully Transferred: 999961

Percentage of packet loss (total): 0.0039

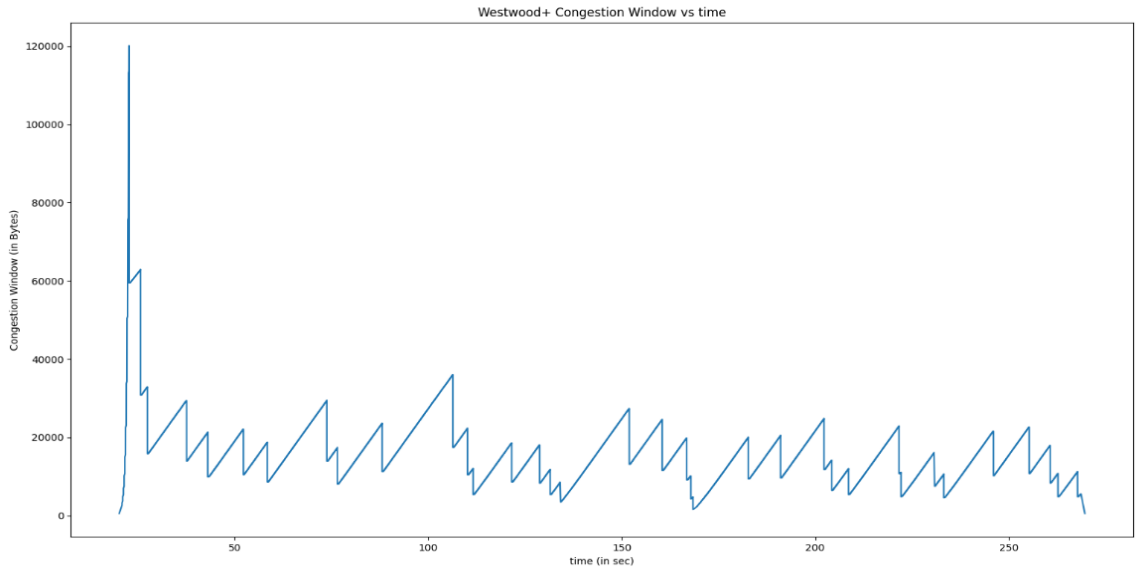
Percentage of packet loss (due to buffer overflow): 0.0

Percentage of packet loss (due to congestion) or Congestion Loss: 0.0039

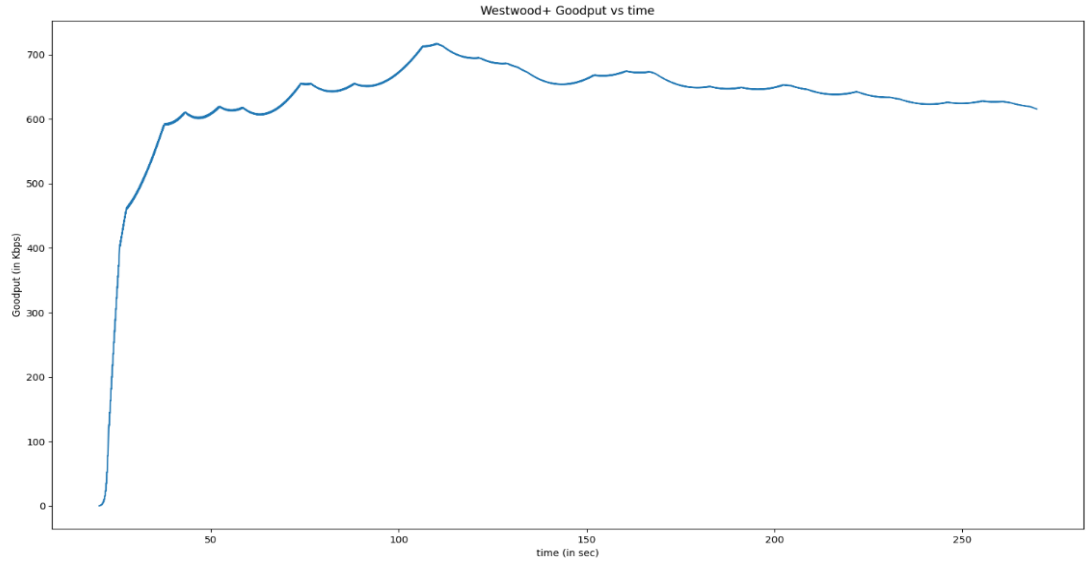
Westwood+ Throughput vs time:



Evolution of congestion window w.r.t time:



Westwood+ Goodput w.r.t time:



- **<u>YeAH-TCP Flow</u>**:

Total Packets transmitted: 1000000

Total Packets Lost: 28

Packets Lost due to buffer overflow: 0

Packets Lost due to Congestion: 28

Maximum throughput (in kbps): 912.871

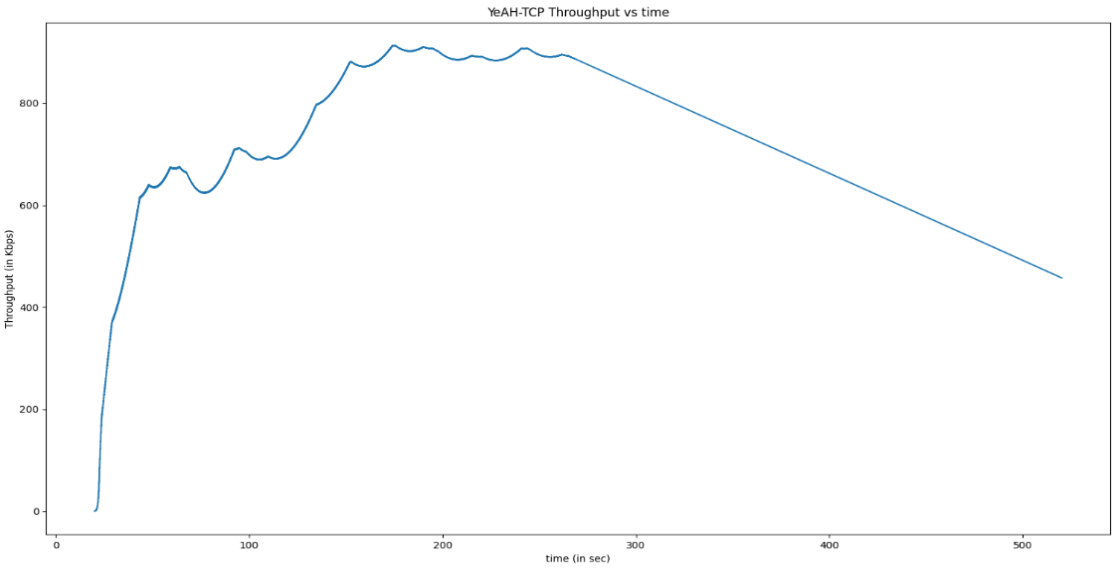
Packets Successfully Transferred: 999972

Percentage of packet loss (total): 0.0028

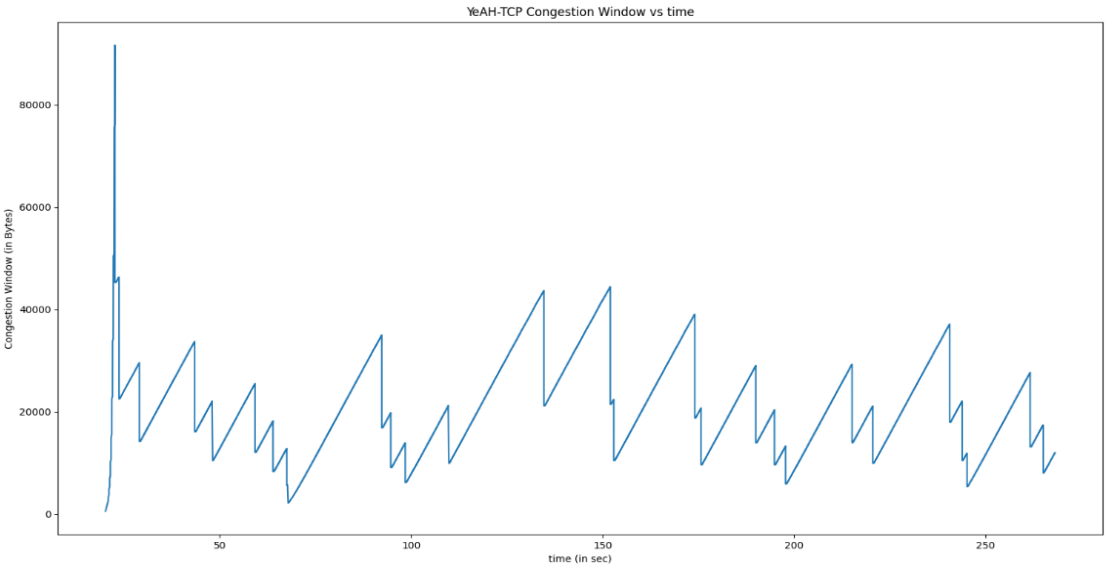
Percentage of packet loss (due to buffer overflow): 0.0

Percentage of packet loss (due to congestion) or Congestion Loss: 0.0028

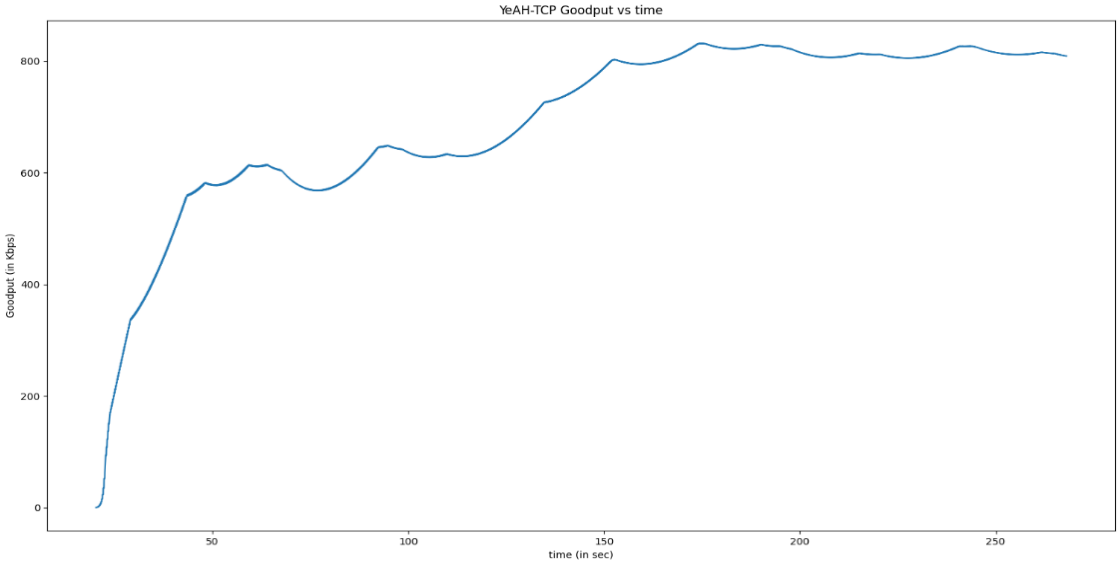
YeAH-TCP Throughput w.r.t time:



Evolution of congestion window w.r.t time:



YeAH-TCP Goodput w.r.t time:



Note: Part(3) of the question is included in part(1) and part(2) itself i.e. the congestion loss and the goodput over the duration of the experiment for each of the flows are mentioned in part(1) and part(2) of the question itself.